Amendments to the Drawings:

The attached sheet of drawings includes new FIG. 5. This sheet, incorporates the elements set forth in pending claim 16, as requested by the Examiner. Support for this amendment can be found at least at page 20, line 23 through page 22, line 4 of the specification, and in original claims 16-20.

Attachment: New sheet showing FIG. 5

REMARKS

I. Status of the Claims

Claims 1-15 were canceled and new claims 21-27 were added in an Amendment and Response to Restriction Requirement, submitted March 11, 2005. Claims 16 and 23-25 have been amended and new claim 28 has been added in the Amendment submitted herewith. No claims have been canceled in the present Amendment. Claims 16-28 are therefore currently pending in the application.

II. Support for the Claims

Claim 16 has been amended to recite "wherein the polymer is a plastic, a thermoplastic, a thermoset or a thermoplastic elastomer". Support for this amendment can be found at least at page 24, lines 17-23 of the specification. Claims 23-25 have been amended to recite that the coefficient of friction is "static". Support for this amendment can be found at least at page 29, Table 3A through page 31, Table 3E. Support for newly added claim 28 can be found at least at page 24, lines 17-23.

III. Support for the Specification

Support for amending the Title of the Invention to read "A Non-Marring Piston Ring Compressor" can be found at least at page 20, line 24 through page 22, line 4. The specification has been amended at page 10, after the paragraph ending at line 25, wherein a paragraph describing new FIG. 5 has been added. Support for this amendment can be found at least at page 20, line 24 through page 22, line 4 and original claim 16.

IV. Drawings Objected to Under 37 C.F.R. § 1.83(a)

The Action states that the drawings are objected to under 37 C.F.R. § 1.83(a), alleging that drawings of the presently claimed piston ring compressor must be shown or the feature(s) must be deleted from the claim(s). Submitted herewith is a drawing (labeled "New

Sheet" FIG. 5) of the piston ring compressor showing a polymer coating on the portion of the piston ring compressor which contacts the piston rings. Applicant therefore respectfully requests withdrawal of the objection.

V. <u>Claims Rejected Under 35 U.S.C. § 103</u>

Claims 16-27 are rejected under 35 U.S.C. § 103 as allegedly being unpatentable over polymers and polymeric coatings in view of Villanyi (U.S. Patent 4,520,542). The Action states that polymers, as well as their respective properties, are known in prior art references and described in Applicant's specification (pages 22-55). The Action acknowledges however, that "none of these references implicitly disclose the application of one of these polymers as a coating, or a major constituent, of a piston ring compressor".

The Action continues, stating that "piston ring compressors are known in the art, however, for the most part, these compressors do not include a coating to protect the piston and piston rings from damage during installation". In applying the Villanyi patent against the presently claimed invention, the Action contends that Villanyi (which discloses a piston ring compressor) "recognizes several problems in the installation of pistons in an IC [internal combustion] engine, including, but not limited to damaging the piston rings, and thus teaches that it would be desirable to provide a coating (Villanyi relies on chrome plating) on the piston ring compressor in order to reduce the possibility of damaging the piston rings".

The Action concludes, that "it would have been obvious to one having skill in the art at the time the invention was made to have taken the teaching from the prior art with respect to polymers and applied it to a piston ring compressor, as Villanyi teaches that it would be desirable to provide a low friction coating on a piston ring compressor in order to reduce the possibility of damaging the piston ring during installation". Applicant respectfully traverses this rejection.

Applicant does not dispute the allegation that piston ring compressors are commonly known and used in the art. In fact, the design of piston ring compressors has been evolving in the mechanical arts for nearly 100 years. For example, U.S. Patent No. 861,342 (granted

July 30, 1907) describes an improved piston ring compressor that locks the piston rings into the piston grooves during the arduous and technically difficult process of inserting a piston/rings into a cylinder bore. The difficulty of this process (*i.e.*, transferring a piston and its rings into the cylinder bore) arises because the piston rings (which are of a larger diameter than the piston, typically 0.5-2.0 millimeters larger) must be compressed into the grooves of the piston with a substantial degree of pressure while simultaneously transferring the piston/rings from the ring compressor into the cylinder bore (which has a diameter approximately 0.1-0.6 millimeters larger than the piston).

Thus, the pressure applied to the piston rings *via* the prior art piston ring compressors must be quite exact. For example, if the applied pressure of the ring compressor is too little during assembly, the rings (of the piston/rings assembly) will expand to a diameter larger than the cylinder bore, thereby damaging, marring and/or breaking the piston rings at the cylinder bore/ring compressor interface. On the other hand, if the applied pressure of the ring compressor is too great, the piston and its rings will not easily transfer from the ring compressor into the bore, which if forced out, will tend to mar or scuff the piston (*e.g.*, the piston skirt and lands) and/or the piston rings. Numerous piston ring compressor design iterations have followed 861,342 patent, such as described in U.S. Patent Nos. 1,458,067; 1,892,989; 2,716,272; 3,374,526; 4,520,542; 5,765,272; 6,389,667 and 6,427,301; each attempting to solve the same difficult problem of transferring a piston and its one or more rings into the bore of a cylinder.

The present invention has identified a novel and unobvious solution to the technically difficult and often damaging process of transferring a piston and its rings into a cylinder bore. The presently claimed invention is directed to a piston ring compressor comprising a <u>polymer coating</u> on the portion of the compressor which contacts the piston and piston rings. Applying a polymer coating to the ring compressor, as set forth and described in the specification (page 20, line 23 through page 22, line 4), provides a <u>protective barrier</u> between the ring compressor and the piston/ring assembly which "protects the <u>piston</u> and <u>piston rings</u> from being scratched, marred or damaged" during assembly into the bore of a

cylinder. In addition to protecting the piston and rings during assembly, the polymers of the invention "reduce[s] friction between the piston/piston rings and the piston rings compressor, thereby reducing piston/piston ring binding in the compressor, which facilitates transfer of the piston from the compressor into the cylinder" (emphasis added).

Applicant contends that none of the prior art references teach or suggest the use of a polymer coating that protects a piston/rings and/or facilitates transfer of a piston/rings into the cylinder. Furthermore, and in particular, Applicant asserts that the Villanyi patent (U.S. Patent 4,520,542) cited in the present Action does not teach nor suggest the use of any polymer coating that protects a piston/rings and/or facilitates transfer of a piston/rings into the cylinder.

For example, the Villanyi patent is directed to an improved piston ring compressor "for installing a piston in an engine block which permits accurately and precisely orienting and locating a piston assembly with respect to an engine block cylinder bore and which has the hand operable tool attachable to the engine block. The hand operable tool includes mounting means thereon for attaching the apparatus to an engine block and accurately and precisely orienting and locating the hand operable tool with respect to an engine block cylinder bore." The Villanyi patent mentions (column 3, lines 60-64) that the bore of the improved piston compressor can be chrome plated to reduce ring friction (and surface wear of the compressor), thereby reducing the possibility of damaging the rings.

Applicant contends however, for the reasons set forth below, that chrome plating a ring compressor, as suggested in the Villanyi patent (which might reduce ring friction and/or protect the rings), does not overcome the problem of piston damage associated with the compressive forces of the ring compressor. For example, as stated previously, if the applied pressure of the ring compressor is too great (*e.g.*, the ring compressor is over-tightened), the piston and its rings will not easily transfer from the ring compressor into the cylinder bore, which if forced out, will mar or scuff the piston.

Applicant submits that it is known in the art that chromium is a much harder material than alloy steel (*e.g.*, alloy steel is often chromium (or chrome) plated to harden and/or

strengthen the outer surface properties of alloyed steel), and as such, chrome plating a steel ring compressor would actually increase the probability of piston damage in the scenario described above (*i.e.*, over-tightening the ring compressor). For example, chromium has a Brinell hardness of approximately 1120 (**Appendix B**), whereas 1000 series alloy steel has a Brinell hardness of approximately 229 (**Appendix C**). Furthermore, given the fact that pistons are almost exclusively made of cast or forged 2618 aluminum (having a Brinell hardness of approximately 115 (**Appendix D**)), the compressive forces of a chrome plated ring compressor would almost certainly damage the 10 fold softer (aluminum) piston skirt and/or piston ring lands in the scenario described above.

In contrast, Applicant contends the presently claimed polymer coatings are both physically and functionally distinct from the chrome plating described in the Villanyi patent. For example, the polymers of the present invention are physically softer than both the metal piston and the metal piston rings, each of which the polymer coated ring compressor contacts during assembly. Thus, in the scenario set forth above (*i.e.*, over-tightening the ring compressor), the polymer will absorb the compressive forces instead of the piston and/or piston rings, thereby serving as a protective barrier between the ring compressor and the piston/ring assembly.

Furthermore, Applicant contends that extrapolating the chrome plating description in Villanyi and applying it to the presently claimed polymer coatings is an "obvious-to-try" rejection, which is not the standard for obviousness under 35 U.S.C. § 103. "Obvious-to-try has long been held not to constitute obviousness". *In re O'Farrell, 853 F.2d 894, 903, 7 U.S.P.Q.2d 1673, 1680-81 (Fed. Cir. 1988).* An obvious-to-try situation exists when a general disclosure may pique the scientist's curiosity, such that further investigation might be done as a result of the disclosure, but the disclosure itself does not contain a sufficient teaching of how to obtain the desired result, or that the claimed result would be obtained if certain directions were pursued. *In re Eli Lilly & Co., 902 F.2d 943, 14 U.S.P.Q.2d 1741, 1743 (Fed. Cir. 1990).*

More specifically, as was stated in *In re Dow Chemical*, 5 USPQ2d 1529, 1532 (Fed.Cir. 1988), "obvious to experiment" is not an appropriate test of obviousness: "The PTO presents, in essence, an 'obvious to experiment' standard for obviousness. However, selective hindsight is no more applicable to the design of experiments than it is to the combination of prior art teachings. There must be a teaching or suggestion in the art for selecting the procedure used, other than the knowledge learned from the applicant's disclosure." Absent the polymer teachings of the present invention, Applicant contends that the Villanyi disclosure does not suggest the use of polymers nor how to obtain or derive the presently claimed polymer coated piston ring compressor.

Furthermore, as enunciated by the Supreme Court in *Graham v. John Deere Co.* (383 U.S. 1, USPQ 459 (1966)), "Such secondary considerations as commercial success, long felt but unresolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or non-obviousness, these inquiries may have relevancy..." Applicant submits that numerous piston ring compressor patents have been granted subsequent to the 1985 Villanyi patent, each alleging an improved design to facilitate the transfer of the piston/rings from the ring compressor into the cylinder. However, Applicant emphasizes that there has been, <u>and still is</u>, a long felt need in the mechanical arts for an improved piston ring compressor which reduces or prevents the aforementioned technical difficulties. Applicant asserts that the present invention fulfills this long felt need, by providing a novel and unobvious polymer coated piston ring compressor.

Thus, Applicant contends that the Villanyi patent disclosure itself does not suggest the use of a polymer coated piston ring compressor, nor does it contain any teaching of how to derive a polymer coated piston ring compressor, or that the claimed polymer coated piston ring compressor would be obtained if certain directions were pursued. Applicant therefore asserts that the disclosure of the Villanyi patent, taken alone or in combination with polymers known in the art, does not render the presently claimed invention obvious, and as such, respectfully requests withdrawal of the rejection of claims 16-28 under 35 U.S.C. § 103.

It is the Applicant's belief that claims 16-28 are in condition for allowance, and action towards that effect is respectfully requested. If there are any matters which may be resolved or clarified through a telephone interview, the Examiner is requested to contact the undersigned Agent at the number indicated.

The notice set a three-month period to comply, to and including July 12, 2005. Thus, this response is believed to be timely filed.

Respectfully submitted,

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Periodic Table of Elements

Element Chromium - Cr

Comprehensive data on the chemical element Chromium is provided on this page; including scores of properties, element names in many languages, most known nuclides of Chromium. For many elements information on common compounds of is now provided as well. In addition technical terms are linked to their definitions and the menu contains links to related articles that are a great aid in one studies. Using the "Periodic Table of Elements Quick Navigation" graphic at the bottom of the sidebar menu, one can quickly jump from chemical element to chemical element.

Chromium Menu

Overview of Chromium

- Atomic Number: 24
- Group: 6
- Period: 4
- Series: Transition Metals

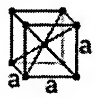
Chromium's Name in Other Languages

- **Latin:** Chromium
- **Czech:** Chrom
- **Croatian:** Krom
- **French:** Chrome
- **German:** Chrom - r
- **Italian:** Cromo
- **Norwegian:** Krom
- **Portuguese:** Cromo
- **Russian:** Хром

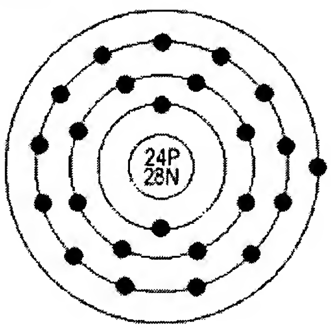
- **Spanish:** Cromo
- **Swedish:** Krom

Atomic Structure of Chromium

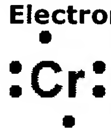
- **Atomic Radius:** 1.85Å
- **Atomic Volume:** $7.23cm^3/mol$
- **Covalent Radius:** 1.18Å
- **Cross Section:** 3.1barns ±0.2
- **Crystal Structure:** Cubic body centered



- **Electron Configuration:**
  $1s^2\ 2s^2p^6\ 3s^2p^6d^5\ 4s^1$
- **Electrons per Energy Level:** 2,8,13,1
  Shell Model



- **Ionic Radius:** 0.52Å
- **Filling Orbital:** $3d^5$
- **Number of Electrons (with no charge):** 24
- **Number of Neutrons (most common/stable nuclide):** 28
- **Number of Protons:** 24
- **Oxidation States:** 6,**3**,2
- **Valance Electrons:** $3d^5\ 4s^1$
  Electron Dot Model



Chemical Properties of Chromium

- **Electrochemical Equivalent:** 0.32333g/amp-hr
- **Electron Work Function:** 4.5eV
- **Electronegativity (Pauling):** 1.66
- **Heat of Fusion:** 16.9kJ/mol
- **Incompatiblities:**
  Strong oxidizers (such as hydrogen peroxide), alkalis
- **Ionization Potential**
  First: 6.766
  Second: 16.5
  Third: 30.96

- **Valance Electron Potential (-eV):** 170

Physical Properties of Chromium

Note: temperature and pressure sensitive calculations are based on normal temperature and pressure (20°C @ 1atm).

- **Atomic Mass Average:** 51.9961
- **Boiling Point:** 2945K 2672°C 4842°F
- **Coefficient of lineal thermal expansion:**
  0.0000062cm/cm/°C (0°C)
- **Conductivity**
  Electrical: 0.0774 10^6/cm Ω
  Thermal: 0.937 W/cmK
- **Density:** 7.19g/cc @ 300K
- **Description:**
  Hard brittle gray transition metal.
- **Elastic Modulus:**
  Bulk: 160/GPa
  Rigidity: 115/GPa
  Youngs: 279/GPa
- **Enthalpy of Atomization:** 397.5 kJ/mole @ 25°C
- **Enthalpy of Fusion:** 15.31 kJ/mole
- **Enthalpy of Vaporization:** 348.8 kJ/mole
- **Flammablity Class:** Non-combustible solid (except as dust)
- **Freezing Point:** *see melting point*
- **Hardness Scale**
  Brinell: 1120 MN m^{-2}
  Mohs: 8.5
  Vickers: 1060 MN m^{-2}
- **Heat of Vaporization:** 344.3kJ/mol
- **Melting Point:** 2130K 1857°C 3375°F
- **Molar Volume:** 7.78 cm^3/mole
- **Pysical State (at 20°C & 1atm):** Solid
- **Specific Heat:** 0.45J/gK
- **Vapor Pressure** = 990Pa@1857°C

Regulatory / Health

- **CAS Number**: 7440-47-3
- **RTECS:** GB4200000
- **OSHA Permissible Exposure Limit (PEL)**
  TWA: 1 mg/m^3
  Notes: The PEL also applies to insoluble chromium salts.
- **OSHA PEL Vacated 1989**
  TWA: 1 mg/m^3
  Notes: The PEL also applies to insoluble chromium salts.
- **NIOSH Recommended Exposure Limit (REL)**
  TWA: 0.5 mg/m^3
  IDLH: 250 mg/m^3
- **Routes of Exposure:** Inhalation; Ingestion; Skin and/or eye contact

- **Target Organs:** Eyes, skin, respiratory system

Who / Where / When / How

- **Discoverer:** Louis Vauquelin
- **Discovery Location:** France
- **Discovery Year:** 1797
- **Name Origin:**
  Greek: chrôma (color).
- **Sources:**
  Does not occur free in nature. Chromite [Fe,Mg(CrO_4)] is its most important mineral.
- **Uses:**
  Used to make stainless steel. Also used in plating for car parts, tools, knives, camouflage paint, stereos, video tapes and lasers. It gives rubies and emeralds their color.
- **Additional Notes:**

Chromium Menu

Please link to this page

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Periodic Table of Elements: Chromium - Cr (EnvironmentalChemistry.com) - Comprehensive information for the element Chromium - Cr is provided by this page including scores of properties, element names in many languages, most known nuclides and technical terms are linked to their definitions.

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AISI 1060 Steel, normalized at 900°C (1650°F)

Return to last search

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Material suppliers

Subcategory: AISI 1000 Series Steel; Carbon Steel; High Carbon Steel; Metal

Key Words: AMS 7240, ASTM A29, ASTM A510, ASTM A576, ASTM A682, UNS G10600

Component	Wt. %
C	0.55 - 0.66
Fe	98.35 - 98.85
Mn	0.6 - 0.9
P	Max 0.04
S	Max 0.05

Material Notes:
Has characteristics similar to those of AISI 1055

Click here to view available vendors for this material.

Physical Properties	Metric	English	Comments
Density	7.85 g/cc	0.284 lb/in³	

Mechanical Properties	Metric	English	Comments
Hardness, Brinell	229	229	
Hardness, Knoop	252	252	Converted from Brinell hardness.
Hardness, Rockwell B	96	96	Converted from Brinell

			hardness.
Hardness, Rockwell C	19	19	Converted from Brinell hardness.
Hardness, Vickers	241	241	Converted from Brinell hardness.
Tensile Strength, Ultimate	779 MPa	113000 psi	
Tensile Strength, Yield	420 MPa	60900 psi	
Elongation at Break	18 %	18 %	In 50 mm
Reduction of Area	32 %	32 %	
Modulus of Elasticity	205 GPa	29700 ksi	Typical for steel
Bulk Modulus	140 GPa	20300 ksi	Typical for steel
Poisson's Ratio	0.29	0.29	Typical For Steel
Izod Impact	14 J	10.3 ft-lb	
Shear Modulus	80 GPa	11600 ksi	Typical for steel

Electrical Properties

Electrical Resistivity	1.8e-005 ohm-cm	1.8e-005 ohm-cm	condition of specimen unknown; 20°C (68°F)

Thermal Properties

CTE, linear 20°C	11 µm/m-°C	6.11 µin/in-°F	20-100ºC
CTE, linear 250°C	12.2 µm/m-°C	6.78 µin/in-°F	0-300°C (68-570°F)
CTE, linear 500°C	13.7 µm/m-°C	7.61 µin/in-°F	0-500°C (68-930°F)
Heat Capacity	0.502 J/g-°C	0.12 BTU/lb-°F	condition unknown; 50-100°C (122-212°F)

Heat Capacity at Elevated Temperature	0.544 J/g-°C	0.13 BTU/lb-°F	condition unknown; 150-200°C (302-392°F)
Thermal Conductivity	49.8 W/m-K	346 BTU-in/hr-ft²-°F	Typical steel

Printer friendly version

References for this datasheet.

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Aluminum 2618-T61

Subcategory: 2000 Series Aluminum Alloy; Aluminum Alloy; Metal; Nonferrous Metal

Close Analogs:

Composition Notes:
Aluminum content reported is calculated as remainder.
Composition information provided by the Aluminum Association and is not for design.

Key Words: UNS A92618; Aluminium 2618-T61; AA2618-T61

Component	Wt. %	Component	Wt. %	Component	Wt. %
Al	92.4 - 94.9	Ni	0.9 - 1.2	Si	0.1 - 0.25
Cu	1.9 - 2.7	Other, each	Max 0.05	Ti	0.04 - 0.1
Fe	0.9 - 1.3	Other, total	Max 0.15	Zn	Max 0.1
Mg	1.3 - 1.8				

Material Notes:
Data points with the AA note have been provided by the Aluminum Association, Inc. and are NOT FOR DESIGN.

Physical Properties	Metric	English	Comments
Density	2.76 g/cc	0.0997 lb/in³	AA; Typical
Mechanical Properties			
Hardness, Brinell	115	115	AA; Typical; 500 g load; 10 mm ball
Hardness, Knoop	144	144	Converted from Brinell Hardness Value
Hardness, Rockwell A	45.5	45.5	Converted from Brinell Hardness Value
Hardness, Rockwell B	72	72	Converted from Brinell Hardness Value
Hardness, Vickers	130	130	Converted from Brinell Hardness

			Value
Ultimate Tensile Strength	441 MPa	64000 psi	AA; Typical
Tensile Yield Strength	372 MPa	54000 psi	AA; Typical
Elongation at Break	10 %	10 %	AA; Typical; 1/2 in. (12.7 mm) Diameter
Modulus of Elasticity	74.5 GPa	10800 ksi	AA; Typical; Average of tension and compression. Compression modulus is about 2% greater than tensile modulus.
Compressive Strength	370 MPa	53700 psi	
Poisson's Ratio	0.33	0.33	
Fatigue Strength	124 MPa	18000 psi	AA; 500,000,000 cycles completely reversed stress; RR Moore machine/specimen
Shear Modulus	27 GPa	3920 ksi	Calculated
Shear Strength	262 MPa	38000 psi	AA; Typical

Electrical Properties

Electrical Resistivity	4.7e-006 ohm-cm	4.7e-006 ohm-cm	

Thermal Properties

CTE, linear 68°F	22.3 µm/m-°C	12.4 µin/in-°F	AA; Typical; Average over 68-212°F range.
CTE, linear 250°C	24 µm/m-°C	13.3 µin/in-°F	Average over the range 20-300°C
Heat Capacity	0.875 J/g-°C	0.209 BTU/lb-°F	
Thermal Conductivity	146 W/m-K	1010 BTU-in/hr-ft²-°F	
Melting Point	549 - 638 °C	1020 - 1180 °F	AA; Typical range based on typical composition for wrought products 1/4 inch thickness or greater
Solidus	549 °C	1020 °F	AA; Typical

Liquidus	638 °C	1180 °F	AA; Typical

Processing Properties

Solution Temperature	529 °C	985 °F	
Aging Temperature	199 °C	390 °F	for 20 hr at temperature

References are available for this material.